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(58) Field of Search
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(54) Abstract Title
Overload clutch

(57) An electric tool machine for rotary and/or impact tools, e.g. an impact drilling machine or hammer drill, has a spindle sleeve (11), driven by an electric motor. A toolholder (12) attached is the spindle sleeve (11) and coupled non-rotatably by locking elements (19) to the spindle sleeve (11). The locking elements (19) for rotary driving of the toolholder (12) are simultaneously designed as load-limiting clutch elements of the overload clutch (20) acting between spindle sleeve (11) and toolholder (12). The elements (19) are loaded by a conical ring member (21) which is biased by spring (22).

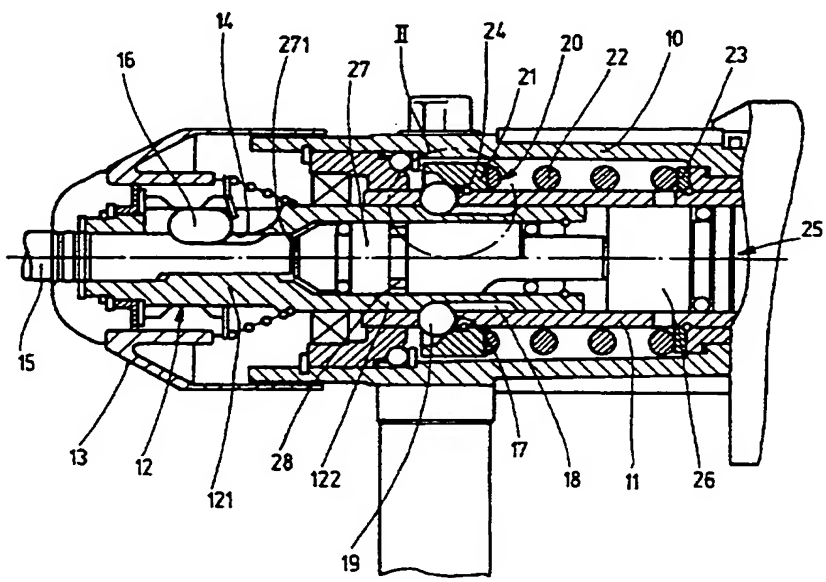

Fig. 1

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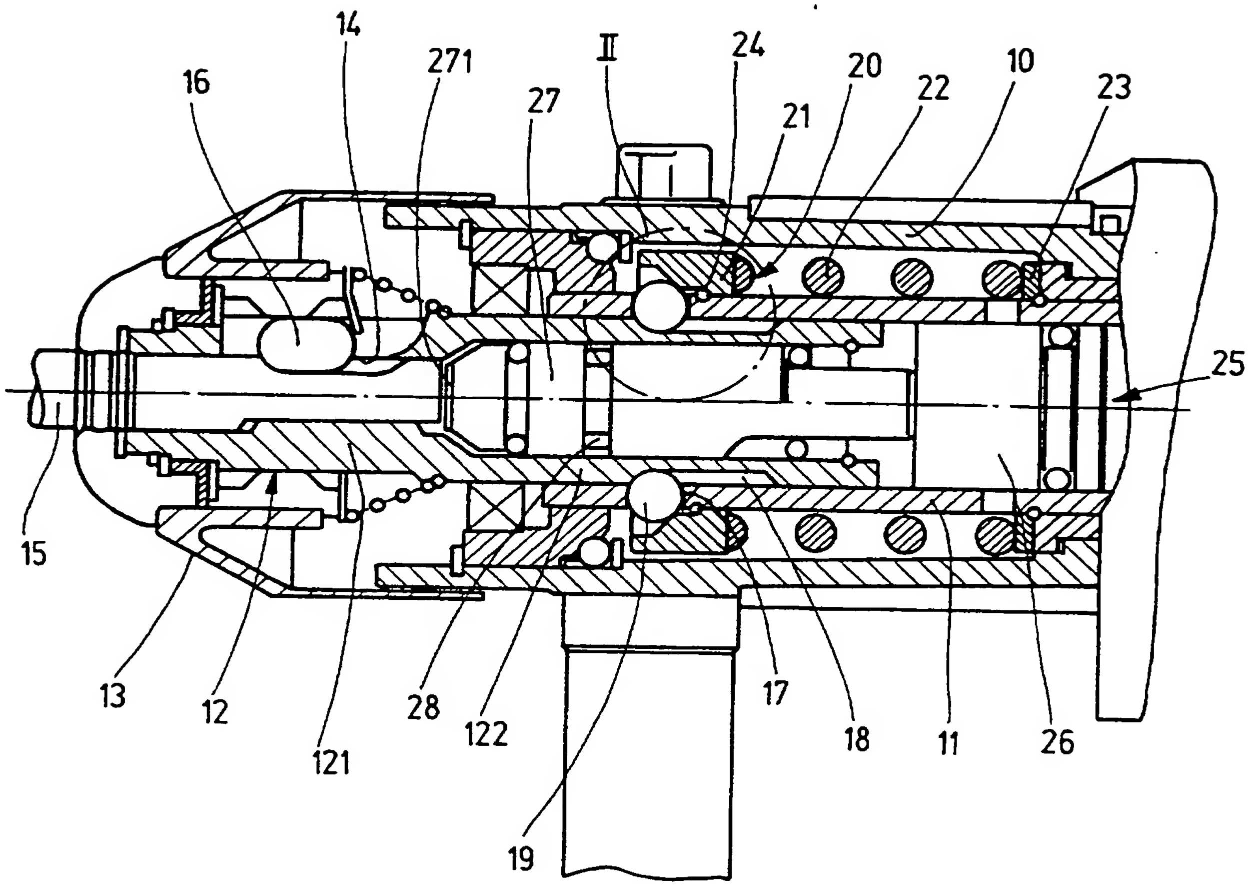
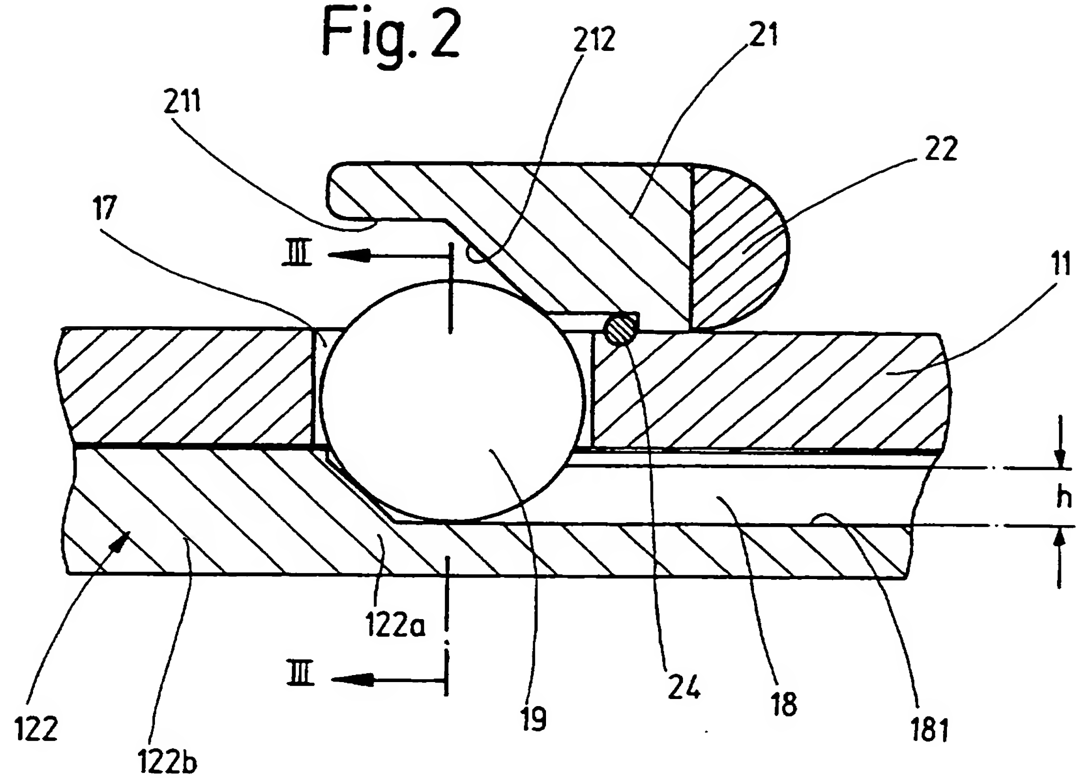


Fig. 1

Fig. 2


212
21
211
22
17
III
11
h
122a
III
24
18
181
19
122
122b

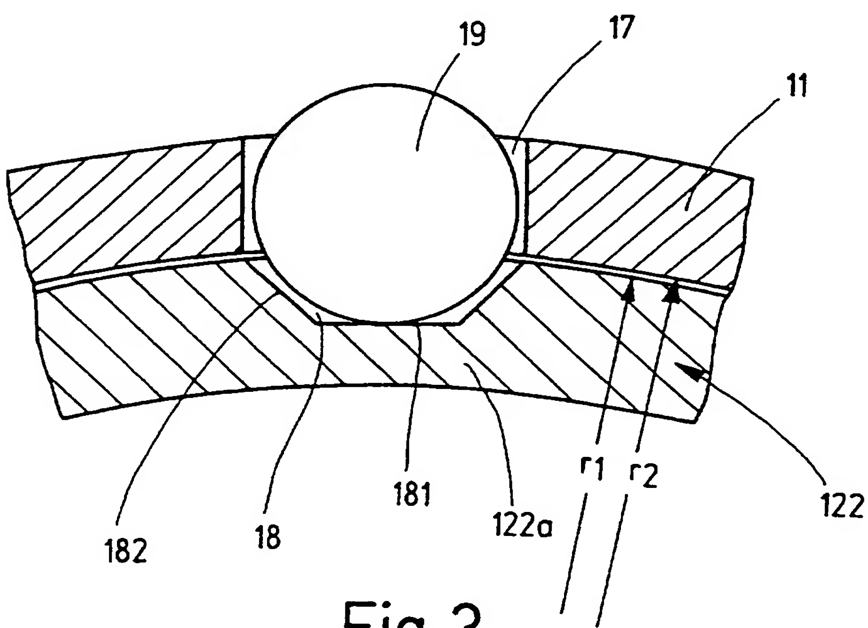

19
17
11
r1
r2
122
182
18
181
122a

Fig. 3

Electric tool machine

Background art

The invention relates to an electric hand tool machine for rotary and/or impact tools, in particular an impact drilling machine or hammer drill, of the type defined in the preamble of claim 1.

Such a hand-guided electric tool machine is known from DE 34 43 186 C2. The toolholder is mounted by means of a hollow cylindrical shank onto the spindle sleeve and fastened thereon by means of the roller-shaped locking elements, which engage through axial slots in the shank into corresponding pockets formed in the spindle sleeve. The function of the locking elements is, on the one hand, rotary driving of the toolholder and, on the other hand, axially displaceable mounting of the toolholder on the spindle sleeve. The header lying in an axially displaceable manner inside the spindle sleeve is guided with a reduced-diameter portion in an axially displaceable manner in the toolholder and, under the action of the striker of the impact mechanism, hammers upon the end face of a tool such as a hammer drill clamped in a frictionally connected manner in the toolholder by means of clamping jaws, with the result that the toolholder and the tool clamped in the toolholder during operation execute a rotating and percussive (hammering) motion as a result of the rotating spindle sleeve and the acceleration of the striker in the direction of the header.

From DE 38 44 311 A1 it is known to equip a drilling machine with an overload clutch in order to safeguard the operator holding the drilling machine in the event of seizing of the drill in the machining surface. The overload clutch in said case is disposed between a gear wheel driven by an output shaft of an electric motor and the spindle sleeve carrying the toolholder and is realized by working, in the end face of the gear wheel seated in a freely rotating manner on the spindle sleeve, detent recesses into which roller-shaped detent bodies with

radially directed body axes engage at least halfway and by pressing the gear wheel by means of a clutch spring in the form of a compression spring against a disc, which is connected non-rotatably to the spindle sleeve and has detent cavities, which correspond to the detent recesses in the ring gear, for receiving the detent bodies. In the event of seizing of the drill during operation of the drilling machine, e.g. as a result of reinforcing iron in reinforced concrete, the detent bodies move out of the detent cavities but remain in the detent recesses of the gear wheel. Thus, the gear wheel is displaced towards the clutch springs and continues to rotate, since it is still driven by the output shaft, without driving the disc and hence the spindle sleeve.

Advantages of the invention

The electric tool machine according to the invention having the characterizing features of claim 1 has the advantage of realizing an overload clutch for the drilling and hammering mode of the machine in a simple manner using few additional structural elements. The mounting for the toolholder on the spindle sleeve and the overload clutch form an integrated structural unit, in which the locking elements of the mounting additionally perform the function of the clutch- or detent elements of the overload clutch. Thus, the design of the electric tool machine despite an additional overload clutch remains simple and as a result of reducing the number of parts and the assembly time a cost benefit is achieved in terms of manufacturing costs.

Advantageous developments and improvements of the electric tool machine indicated in claim 1 are possible by virtue of the measures outlined in the further claims.

According to a preferred embodiment of the invention, the integration of the mounting of the toolholder on the spindle sleeve and the overload clutch between spindle sleeve and toolholder is realized in a particularly

simple manner in that the spindle sleeve overlaps a hollow cylindrical shank of the toolholder and in the overlap region has radial openings, which are distributed over the periphery and penetrate the sleeve wall. Countersunk in the shank of the toolholder are pockets radially aligned with the openings, and the locking elements take the form of rolling bodies, which are guided in the openings and may engage into the pockets and be supported against the pocket base, it being preferred that the rolling bodies take the form of balls and the openings in the spindle sleeve take the form of radial bores. The overload clutch in said case is supplemented by a supporting ring, which embraces the rolling bodies projecting from the openings, and by a clutch spring preferably in the form of a compression spring which is mounted on the spindle sleeve. The supporting ring has an axially aligned inner ring surface, which overlaps the rolling bodies with radial clearance, and a conical support surface, which lies against the rolling bodies and forms an obtuse angle with the inner ring surface. The clutch spring is supported, on the one hand, against the supporting ring and, on the other hand, against an abutment fixed in an axially non-displaceable manner on the spindle sleeve. To guarantee the axial mobility of the toolholder, the supporting ring is applied under the action of the clutch spring against a stop fixed in an axially non-displaceable manner on the spindle sleeve, its support surface touching but not clamping the rolling bodies.

According to an advantageous embodiment of the invention, the shank portion of the toolholder containing the pockets is reduced in diameter and the radial clearance of the inner ring surface from the rolling bodies is less than the sum of the radial depth of the pockets and the difference in radius between the shank portion having the pockets and the shank portion immediately adjacent to said operating end remote from the toolholder. By virtue of the radial annular shoulder thus formed at least at the rear pocket end and by virtue of limiting the maximum radial rolling body travel to a value which does not exceed said annular shoulder, the toolholder in the event of blocking of the tool is reliably prevented from being torn out of the spindle sleeve because the rolling bodies are supported

against the rear annular radial shoulder.

Drawings

There follows a detailed description of an embodiment of the invention which is illustrated in the drawings. The drawings show:

Fig. 1 in a cutout manner a longitudinal section of a hammer drill,

Fig. 2 an enlarged view of the cutout II in Fig. 1,

Fig. 3 a section along the line III-III in Fig. 2.

Description of the embodiment

The hammer drill, which is illustrated in a cutout manner and in longitudinal section in Fig. 1 as an embodiment of a general, in particular hand-guided electric tool machine for rotary and/or impact tools, comprises a housing 10, in which a spindle sleeve 11 driven via a gearing by an electric motor (not shown here) is rotatably supported. Attached to the front end of the spindle sleeve 11 is a toolholder 12, which projects from the housing 10 and with a protective cap 13 overlaps the front end of the housing 10 with clearance. The toolholder 12 comprises a chuck body 121 with a central location bore 14 for the insertion of a shank of a tool 15 and, as an integral extension thereof, a hollow cylindrical shank 122 which inside the housing 10 is overlapped with slight clearance by the front end of the spindle sleeve 11. The tool to be inserted into the location bore 17 is fixed in a non-rotatable manner in the chuck body 121 and prevented from unintentionally sliding axially out of the chuck body 121 by means of a quick-release locking element 16. The toolholder 12 is coupled to the spindle sleeve 11

in a non-rotatable and, to a limited extent, axially displaceable manner. To said end, the spindle sleeve 11 has, in its region of overlapping of the shank 122, a plurality of radial bores 17 which are distributed over the periphery and fully penetrate the sleeve wall, and there are countersunk in the shank 122 of the toolholder 12 axial pockets 18, which are radially aligned with the radial bores 17 and whose axial length is a multiple of the bore diameter of the radial bores 17. Guided in the radial bores 17 are locking elements in the form of balls 19, which project from the inside and outside of the spindle sleeve 11 and may be supported against the pocket base 181 of the pockets 18. The balls 19 lying with slight clearance in the radial bores 17 and engaging into the pockets 18 guarantee the rotary driving of the toolholder 12 during rotation of the spindle sleeve 11 and at the same time allow a limited axial displacement of the toolholder 12 by a displacement distance predetermined by the axial length of the pockets 18.

Disposed between the spindle sleeve 11 and the toolholder 12 is an overload clutch 20 which, in the event of blocking of the tool in the machining surface e.g. as a result of reinforcing iron in reinforced concrete, automatically uncouples the toolholder 12 from the spindle sleeve 11 so that the latter may rotate freely while the toolholder 12 is stationary. Said overload clutch 20 utilizes the locking elements in the form of balls 19 provided for the non-rotatable and axially displaceable mounting of the toolholder 12 on the spindle sleeve 11 as load-limiting clutch- or detent elements and additionally comprises a supporting ring 21 and a clutch spring 22 in the form of a compression spring, which is mounted onto the spindle sleeve 11 and supported, on the one hand, against the supporting ring 21 and, on the other hand, against an abutment 23 fixed in an axially non-displaceable manner on the spindle sleeve 11. The supporting ring 21, which embraces the balls 19 projecting from the radial bores 17, has an axially aligned inner ring surface 211 overlapping the balls 19 with radial clearance and a conical support surface 212, which lies against the balls 19 and forms an obtuse angle with the inner ring surface 211 (Fig. 2). To guarantee the axial mobility of the

toolholder 12, a stop for the supporting ring 21 is formed by means of a snap ring 24, which is inserted into a peripheral groove in the spindle sleeve 11, and prevents the clutch spring 22 from clamping the balls 19 firmly over the support surface 212. The position of the snap ring 24 is so selected that the conical support surface 212 just touches the balls 19 without exerting an axial displacement force upon the balls 19. The lateral boundary walls 182 of the pockets 18 pointing in a peripheral direction of the shank 122 and extending in axial direction are inclined relative to the radial plane so that they form an obtuse angle with the pocket base 181 (Fig. 3). Said inclination of the lateral boundary walls 182 facilitates the disengagement of the balls 19 from the pockets 18 in the event of overload.

In the event of overload, the torque at the spindle sleeve 11 is greater than the detent moment applied by the balls 19 and the clutch spring 22 between spindle sleeve 11 and toolholder 12. The balls 19 then slide radially outwards over the lateral boundary walls 182 and, in so doing, displace the supporting ring 24 via the latter's support surface 212 counter to the action of the clutch spring 22. The moment the balls 19 are fully disengaged from the pockets 18, the overload clutch 20 is released and the spindle sleeve 11 may rotate relative to the toolholder 12. To enable full disengagement of the balls 19 from the pockets 18 in the event of overload, the radial clearance of the inner ring surface 211 of the support ring 21 from the surface of the balls 19 is made slightly greater than the difference between the ball diameter of the balls 19 and the radial depth or height h (Fig. 2) of the pockets 18; in other words, the radial distance of the inner ring surface 211 from the pocket base 181 is slightly greater than the sum of ball diameter and pocket depth h.

As Figs. 2 and 3 reveal, the shank portion 122a, containing the pockets 18, of the hollow cylindrical shank 122 of the toolholder 12 is slightly reduced in diameter. The axial length of said shank portion 122a corresponds exactly to the axial length of the pockets 18. The radius of the outer surface of the

reduced-diameter shank portion 122a is denoted in Fig. 3 by r_1 and the radius of the outer surface of the remaining shank 122 is denoted by r_2. The radial clearance of the inner surface 211 of the supporting ring 21 from the balls 19 is additionally made smaller than the sum of the radial depth h of the pockets and the radius difference $r_2 - r_1$ between the radius r_1 of the shank portion having the pockets 18 and the radius r_2 of the two shank portions 122b immediately adjacent thereto. By virtue of said radius difference $r_2 - r_1$ a radial shoulder is formed at each of the two end faces of the pockets 18, which end faces are aligned at right angles to the axial direction. In an overload situation, the balls 19 are supported against the rear annular shoulder (not visible in Fig. 2) lying closer to the free shank end remote from the toolholder 12 and prevent the toolholder 12 from being torn out of the spindle sleeve 11. The above-mentioned dimensioning of the radial clearance of the inner ring surface 211 of the supporting ring 21 from the balls 19 prevents said radial annular shoulders from being surmounted by the balls 19.

The hammer drill has, for additional axial driving of the rotating tool 15, an impact mechanism 25 of which Fig. 1 shows in a cutout manner a striker 26, which is guided in an axially displaceable manner inside the spindle sleeve 21, and a header 27, which lies in an axially displaceable manner inside the hollow cylindrical shank 122 of the toolholder 12 and is applied by its front end 271 remote from the striker 26 against the opposing end face of the tool 15 held in the toolholder 12. The striker 26 is accelerated in axial direction by a drive (not shown here) and strikes against the header 27, which transmits said impact force directly to the tool 15. The toolholder 12 is, as a result of the tool contact pressure exerted by the operator, shifted in the direction of its end position of deeper engagement into the spindle sleeve 11. A sealing ring 28, which is inserted into a peripheral groove of the header 27 and supported against the inner wall of the shank 122 of the toolholder 12, prevents lubricant from escaping in a forward direction.

The invention is not limited to the embodiment described above.

Thus, the balls 19 used simultaneously as clutch- or detent elements of the overload clutch 20 and as locking elements for rotary driving and axial guidance of the toolholder 12 by the spindle sleeve 11 may alternatively be replaced by other forms of rolling body, e.g. by rollers having roller axes aligned parallel to the spindle sleeve axis. The hollow cylindrical shank of the toolholder may alternatively overlap the front end of the spindle sleeve, in which case the pockets for engagement of the rolling bodies are disposed in the spindle sleeve 11 and the radial openings for guiding the rolling bodies are disposed in the hollow cylindrical shank of the toolholder. The supporting ring of the overload clutch is then seated, like the clutch spring, on the shank of the toolholder. Furthermore, it is possible to dispense with the displaceability of the toolholder 12 in an axial direction relative to the spindle sleeve 11 and to couple the toolholder 12 exclusively in a non-rotatable manner to the spindle sleeve 11. In said case, the length of the axial pockets 18 is substantially reduced so that the balls 19 or rolling bodies engage only with slight clearance into the pockets 18.

CLAIMS

1. Electric tool machine for rotary and/or impact tools, in particular an impact drilling machine or hammer drill, having a spindle sleeve (11) driven by an electric motor, having a toolholder (12) attached to the spindle sleeve (11) and coupled non-rotatably by locking elements to the spindle sleeve (11), characterized in that the locking elements (rolling bodies 19) are simultaneously designed as load-limiting clutch elements of an overload clutch (20) acting between spindle sleeve (11) and toolholder (12).

2. Machine according to claim 1, characterized in that the spindle sleeve (11) overlaps a hollow cylindrical shank (122) of the toolholder (12) and in the overlap region has radial openings (17), which are distributed over the periphery and penetrate the sleeve wall, that axial pockets (18) are countersunk in the shank (122) of the toolholder (12) and radially aligned with the openings (17) and that the locking elements take the form of rolling bodies (19), which are guided in the openings (17) and engage into the pockets (18).

3. Machine according to claim 2, characterized in that the rolling bodies (19) projecting from the openings (17) are embraced by a supporting ring (21), which forms a part of the overload clutch (20) and has an axially aligned inner ring surface (211) overlapping the rolling bodies (19) with radial clearance and a conical support surface (212), which rests against the rolling bodies (19) and forms an obtuse angle with the inner ring surface (211), and that the supporting ring (21) enclosing the spindle sleeve (11) is applied by an axially directed spring force against a stop (24) fixed in an axially non-displaceable manner on the spindle sleeve (11).

4. Machine according to claim 3, characterized in that the overload

clutch (20) has a clutch spring (22) in the form of a compression spring, which is seated on the spindle sleeve (11) and supported between the supporting ring (21) and an abutment (23) fixed in an axially non-displaceable manner on the spindle sleeve (11).

5. Machine according to claim 3 or 4, characterized in that the stop is formed by a snap ring (24) inserted in a peripheral groove in the spindle sleeve (11).

6. Machine according to one of claims 2 to 5, characterized in that the lateral boundary walls (182) of the pockets (18), which walls are directed in a peripheral direction of the shank (122) of the toolholder (12) and extend in axial direction, form an obtuse angle with the pocket base (181).

7. Machine according to one of claims 1 to 6, characterized in that the radial clearance of the inner ring surface (211) of the supporting ring (21) from the rolling bodies (19) is slightly greater than the difference between the radial dimension of the rolling bodies (19) and the radial depth (h) of the pockets (18).

8. Machine according to one of claims 3 to 7, characterized in that the shank portion (122a), containing the pockets (18), of the shank (122) of the toolholder (12) is reduced in diameter and that the radial clearance of the inner ring surface (211) of the supporting ring (21) from the rolling bodies (19) is less than the sum of the radial depth (h) of the pockets (18) and the radius difference ($r_2 - r_1$) between the radius (r_1) of the shank portion (122a) having the pockets (18) and the radius (r_2) of the shank portion (122b) immediately adjacent to said shank portion (122a) in the direction of the end of the shank (122) remote from the tool.

9. Machine according to one of claims 2 to 8, characterized in that, for

limited axially displaceable coupling of the toolholder (12) to the spindle sleeve (11), the axial length of the pockets (18) is substantially greater than the dimension, directed in a longitudinal direction of the pockets (18), of the engagement region of the rolling bodies (19).

10. Machine according to one of claims 2 to 9, characterized in that the rolling bodies take the form of balls (19) and the openings in the spindle sleeve (11) take the form of radial bores (17).

11. Machine according to one of claims 1 to 10 having an impact mechanism (25) for axial displacement of the tool (15) held in the toolholder (12), characterized in that the impact mechanism (25) comprises a striker (26) accommodated in an axially displaceable manner in the spindle sleeve (11), a drive accelerating the striker (26) in axial direction and a header (27) transmitting the striker impacts to the tool (15) and that the header (27) is accommodated in an axially displaceable manner in the hollow cylindrical shank (122) of the toolholder (12).

12. An electric machine tool substantially as herein described with reference to the accompanying drawings.